

Let's Talk Water – Droughts

By Dr. Mike Strobel

As I write this article, the rain is coming down in Ely (actually a rain/snow mix). It seems out of place to be writing about drought during a steady rain, but in reality, this might be the best time to have this discussion. Often, we see short-term events as turning points in weather patterns, but we need to step back and look at the bigger (longer) picture. A week of cold weather in June does not prove global warming is false, just as a week of rain in October does not define the end of the drought.

Drought can be defined as “a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected areas” (Glossary of Meteorology, 1959). In other words, drought is a period without rain or snow where normal conditions are changed, such as a lack of soil moisture or reductions in water supplies (water tables, lake levels, streamflow, etc.).

Living in the driest State in the union, one might argue that we in Nevada live with drought all the time. While it certainly is dry here, we still depend on a level of annual precipitation to keep our aquifers replenished and our streams flowing so that we can irrigate crops and fields. Often, winter snowpack in the mountains provides the precipitation to maintain the water balance for the rest of the year. Reductions in that snowpack can mean drought conditions for the valleys.

One might ask if drought is defined by a lack of precipitation, a decline in soil moisture, a drop in streamflow, or when water restrictions are put in place on various cities and areas. The answer is all four. Drought can be defined in reference to meteorological, agricultural, hydrological, or socioeconomical standards (NOAA webpage at www.nimbo.wrh.noaa.gov)

Meteorological drought refers to a period when the amount of precipitation is below normal. This standard can be highly variable from one location to another. For example, let's say that rainfall in Carson City was below normal for a year. However, the precipitation in the Sierra Nevada adjacent to Carson City was at or above normal for the same year. By definition, Carson City would be in a drought, while the nearby mountains are having a good year. The reality is that much of the moisture from the mountain precipitation will probably flow into the valley and therefore supply sufficient water for crops and aquifer recharge, but the valley is still considered under a meteorological drought.

Agricultural drought refers to conditions when soil moisture is insufficient to meet crop needs. Because crops in Nevada depend on irrigation for survival, this definition does not apply to us by itself. However, because drought can affect hydrological conditions, which supply water for irrigation, agricultural drought can be related to hydrological drought. In many places in the eastern United States where irrigation is not used, agricultural drought is a very serious subject.

Hydrological drought refers to conditions when snowpack, lakes levels, streamflow, and ground-water levels are below normal. In a desert environment like Nevada, this type of drought condition is the most serious. Declines in our water supplies can affect the ability to irrigate crops, maintain habitat for animals (both wild and domestic), and provide for human needs. Drought can require that ground water wells are deepened or pumps lowered in order to reach declining water levels. The Southern Nevada Water Authority uses water levels in Lake Mead as an indicator of drought conditions (www.snwa.com).

Socioeconomic drought is when water shortages begin to affect the people. In some cases, a deficit of precipitation can have little effect on people if there are sufficient supplies to keep things as “business as usual.” A lot of this depends on the amount of water in storage and the length of time of the drought. In other cases, a deficit in precipitation (and related declines in water supplies and soil moisture) can have huge socioeconomic effects, such as during the “Dust Bowl” era when people were displaced and ways of life changed. When drought causes a change in lifestyle or business practices, then it has a socioeconomic effect.

Drought is typically measured using a number of different indices. One is the Percent of Normal, which is a measure of precipitation compared to “normal precipitation,” typically considered the 30-year mean. Another index is the Standardized Precipitation Index (SPI) which is based on the probability of precipitation for any time scale, and can provide an early warning of drought and assess drought severity. The Palmer Drought Severity Index (PDSI) is a meteorological drought index based on soil moisture. The Crop Moisture Index (CMI) is similar to the Palmer Index and uses moisture supply as required by certain crops. The Surface Water Supply Index (SWSI) is calculated by river basin and is based on snowpack, streamflow, precipitation, and reservoir storage. The Reclamation Drought Index (RDI) is calculated for river basins and uses the same parameters as SWSI, plus temperature. Most drought observers use one or more of these indices to evaluate drought conditions.

The severity of drought can depend on where you live. In parts of the country where rainfall is critical for crop production and quality of life (lawns, golf courses, etc.), even a few weeks without rain can cause great concern. In the desert southwest, where rainfall is less common, it might take prolonged periods (months or even parts of years) before people feel the effects of drought. For example, people in southern Nevada depend on Lake Mead for their water supply. Lake levels depend on flow from the Colorado River, which is supplied mainly from precipitation in the upper basin (Colorado, Wyoming, and Utah). A prolonged drought in the western United States might not have immediate effects on water supplies from Lake Mead, but over time, the effects would be cumulative and become more apparent to the general public.

One effect of drought that we all can relate to is the increase in forest fires. Fire potential increases as conditions become drier. During a drought in California around 1970, fires accounted for tens of millions of dollars in losses. The drought between 1984 and 1988 had huge effects on agricultural production. During this period, over 4 million acres of

forest burned in the Northwest and over half of Yellowstone National Park, over 2 million acres, was affected by a huge forest fire.

The present drought affecting the western United States has been affecting some areas for more than 5 years. Is this the worst drought in history? That depends on how one ranks drought (severity of moisture deficit, reduced water levels, impacts on humans, spatial area affected by drought, etc.). The drought of the 1930s lasted up to 7 years in some parts of the country and resulted in a mass migration of people from the Great Plains. The cost of losses related to the 1987-89 drought in the United States is estimated to be as high as \$39 billion. As populations continue to grow, the effects of droughts on humans also will increase.

Scientists have been able to examine climate conditions that existed prior to recorded history in the western United States by using paleoclimate data. These data consist of climate conditions recorded in tree rings, lake sediments, ice cores, and other features that are affected by changes in the environment. Tree ring records are abundant for the last few hundred years, and in some cases hold records for the last two thousand years. Lake sediments and ice cores can extend even further back, often many thousands of years. The paleoclimate data indicate that many past droughts appear to have been much worse than those experienced during the last one-hundred years, both in duration and intensity.

In conclusion, droughts are naturally occurring weather patterns that result in a water deficit for an area. The effects of drought on humans relates to reduced water supplies, wells going dry or reduced well production, reduced soil moisture, stresses on the ecological system, increased fire potential, reduced crop production, and often water rationing. Droughts have happened throughout time, but no one can accurately predict how intense a drought will be or how long it will last. Like the weather, all we can do is prepare for what might come and try to minimize the impacts on our lives.

If you have any questions about drought, please write to me in care of the Ely Times or at mstrobel@usgs.gov. Next week marks 6 months this article has appeared in the Ely Times. For the upcoming article, at the request of some readers, I will list hydrologic terms and definitions that relate to various discussions about water.